SEMESTER/MASTER PROJECT PROPOSAL: Sampling, Reconstruction and Uncertainty Quantification for MRI

Index Terms

inverse problems, uncertainty quantification, deep learning, learning-based sampling

Description:

In recent years, deep learning methods have been increasingly applied to inverse problems, such as MRI, with great success [1]. Such methods allow to reconstruct images of good quality from heavily undersampled measurements, which translates into faster scan times, and could consequently lead to a drastically more efficient usage of MRI scanners.

In this project, we are interested in studying how to extend deep learning-based methods to jointly or alternatively optimize sampling (which data points to acquire), as well as reconstruction (how to reconstruct optimally the original data from the acquired data). Using the uncertainty in the reconstructed image as a quantity to minimize has yielded promising results, and has recently started to be more deeply investigated [2], [3]. The state-of-the-art is currently held by reinforcement-learning approaches such as [4], [5], [6].

This project has a broad definition, and different research directions could be explored by the interested student. I am especially interested in exploring the challenging setting of non-Cartesian MRI, but reinforcement learning approaches make an interest topic too. Feel free to contact me (see below) if you are interested in any of these topics!

Prerequisites:

Deep learning experience (ideally on python with pytorch, tensorflow or a similar library), signal/image processing, some knowledge on discrete optimization could be useful.

Contact

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REFERENCES

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[2] Z. Zhang, A. Romero, M. J. Muckley, P. Vincent, L. Yang, and M. Drozdzal, "Reducing uncertainty in undersampled MRI reconstruction with active acquisition," *arXiv preprint arXiv:1902.03051*, 2019.

[3] T. Sanchez, I. Krawczuk, Z. Sun, and V. Cevher, "Uncertainty-driven adaptive sampling via gans," 2020. [Online]. Available: https://openreview.net/pdf/5c7b46785fcbc1ec4c468d12c5f6d8d7ac3a7a68.pdf

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[5] L. Pineda, S. Basu, A. Romero, R. Calandra, and M. Drozdzal, "Active mr k-space sampling with reinforcement learning," *arXiv preprint arXiv:2007.10469*, 2020.

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